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High-resolution, high-speed, spatial light modulators that offer excellent spatial uniformity are the key devices impeding progress in the areas of optical information processing and computing. The thrust of the MIT research effort is in the area of materials, devices and systems for optical information processing. Our research is focused on (1) the growth, processing and characterization of optical crystals for spatial light modulation, (2) spatial light modulator prototype device development and (3) applications of spatial light modulators in symbolic optical processors. This final report describes the purchase assembly and operation of a RF sputtering system that is supporting a number of these and other DOD sponsored research programs at MIT.

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THIN-FILM OPTICS FOR SIGNAL PROCESSING APPLICATIONS

Final Report

AFOSR-86-0288

January 25, 1989

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THIN FILM OPTICS FOR SIGNAL PROCESSING APPLICATIONS

INTRODUCTION

High-resolution, high-speed, spatial light modulators that offer excellent spatial uniformity are the key devices impeding progress in the areas of optical information processing and computing. The thrust of the MIT research effort is in the area of materials, devices and systems for optical information processing. Our research is focused on (1) the growth, processing and characterization of optical crystals for spatial light modulation, (2) spatial light modulator prototype device development and (3) applications of spatial light modulators in symbolic optical processors.

This final report describes the purchase, assembly and operation of a RF sputtering system that is supporting a number of these and other DOD sponsored research programs at MIT.

SPUTTERING SYSTEM PURCHASED

The sputtering system purchased under this grant was built around a MRC 8667 chassis. Before purchasing the MRC 8667 system, we investigated several other competitive models. In particular, serious consideration was given to:

(1) CVC Model 2800 system

(2) Edwards E610 system

Because several of our users require three-target co-sputtering, the basic sputtering unit had to accommodate three guns, and had to be readily modifiable. After careful examination of all three models, we found that the MRC 8667 system would require the least work to achieve the necessary modifications. Furthermore, MRC gave us the best discount on the price.

The major components that constitute the sputtering system were, therefore, purchased from Materials Research Corporation. These were tested and assembled to fabricate the sputtering system. Some of the items were bought

A-1

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used to stay within budget limitations. The major components of the system are listed below:

1. Basic 8667 Module (Model No. 10-8667-0200)
2. Five Inch RF Diode Cathode Assembly (Model No. 10-894-99-004)
3. 2 BA(VHS-6-Diff) Vacuum Station W/M.P.Auto pumpdown (Model No. 10-894-99-035)
4. Used 1.5 kW RF Supply
5. Used 2400 liter/sec. Diffusion Pump
6. Used Liquid Nitrogen Trap
7. Used Throttle Valve

The mechanical pump on the system was purchased under a different contract. A diagram of the control panel of the sputtering system is shown in Fig. 1.

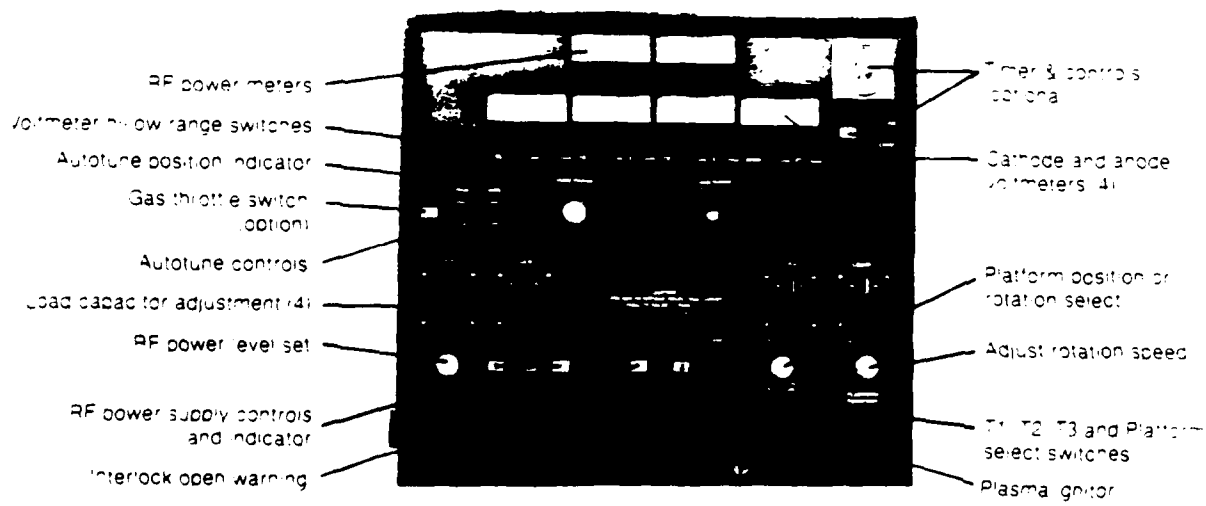

Fig. 1. Control Panel of Sputtering System

BENEFITS OF THE SPUTTERING SYSTEM

Some of the DOD-sponsored programs that are currently being supported by the new sputtering system are listed below:

Sponsor:	DARPA through RADC, Hanscom AFB
Contract No.:	F19628-85-K-0050
Thrust of Research:	Crystal growth, post-growth processing and characterization of the optical, electronic electrooptic and photorefractive properties of doped $BaTiO_3$ crystals. Research involves similar characterization studies on $Bi_{12}SiO_{20}$, $Sr_xBa_{1-x}Nb_2O_6$ and $LiNbO_3$.
Sponsor:	DARPA through AFOSR
Grant No.:	AFOSR-86-0301
Thrust of Research:	Experimental and theoretical investigation of hybrid symbolic optical processing machines for logical inference. Experimental work involves the use of electrically and optically-addressed spatial light modulators to code and manipulate patterns representing the knowledge base, rules, and queries.
Sponsor:	RADC/Hanscom AFB
Contract No.:	F19628-87-C-0173
Thrust of Research:	This program is concerned with the optimization of $BaTiO_3$ crystals for optical computing applications, and it involves the delivery of doped and undoped samples of photorefractive $BaTiO_3$ to Hanscom Air Force Base.

In addition to the programs listed above, there are two other groups within the MIT Crystal Physics Laboratory, who are also involved in insulating oxide crystal growth and characterization that will also be using the sputtering system. These groups are led by Dr. Hans Jenssen and Prof. Harry Tuller.

The above programs all rely on the sputtering machine for: (1) the sputter-deposition of thin transparent conductive electrodes of indium-tin-oxide on $BaTiO_3$, $LiTaO_3$, $Bi_{12}SiO_{20}$, $Sr_xBa_{1-x}Nb_2O_6$ and microchannel plates, and/or (2) the sputter-deposition of insulating layers of materials, such as, SiO and SiO_2.

The acquisition of the requested sputtering now permits us to determine the deposition conditions that are most compatible with each of the above electrooptic and photorefractive materials. Because of the widely varying properties of these materials, and the special handling that is often required the coating of these materials was hitherto not reproducible.

We believe that the in-house quality control that we are now achieving with this sputtering system will considerably improve the chances for significant advances in spatial light modulator technology and optical signal processing research.